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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,185	02/09/2004	Kia Silverbrook	MTB27US	8427

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EXAMINER	
FIDLER, SHELBY LEE	
ART UNIT	**PAPER NUMBER**
2861	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/23/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/773,185	Applicant(s) SILVERBROOK, KIA	
	Examiner Shelby Fidler	Art Unit 2861	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 December 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6,8-25 and 27-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6,8-25 and 27-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12/7/2006*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 5-6, 8, 10-11, 13-15, 19-21, 23-25, 27, 29- 30, 32-34, 38-44, 46-47, and 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook (US 6019457) in view of Kubby (US 5851412) and Hiramatsu et al. (US 6967312 B2).

Regarding claims 1 and 19:

Silverbrook discloses an inkjet printhead (*col. 5, lines 34-38*) and printing system (*Figure 116*) comprising:

a plurality of nozzles (*elements 41, Figure 3*);

a bubble forming chamber corresponding to each of the nozzles (*element 112, Figure 9*);

at least one heater element disposed in each of the bubble forming chambers respectively (*element 120, Figure 12*), the heater element configured for thermal contact with a bubble forming liquid (*heater 120 in thermal contact with ink 106, Figure 12*), such that,

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element (*col. 9, lines 26-28*); wherein,

the heater element is an elongated strip (*element 441, Figure 13*), and

the heater element has a serpentine form (*Fig. 13*) that extends between two adjacent electrodes (*electrodes 442, Fig. 13*) spaced from each other by a gap (*gap between electrodes 442 of Fig. 13*).

Silverbrook does not expressly disclose that the heater element is a suspended, cantilevered strip that has a second gap diametrically opposed to the gap between the electrodes.

However, Kubby discloses a serpentine heater element (*e.g. doped region 22*) that is suspended and cantilevered (*col. 4, lines 5-10; note that any number of legs 19 can be used; using two legs makes the heater element cantilevered*), wherein the heater element extends between two adjacent electrodes (*conductors 24 on legs 19; Fig. 1*) spaced from each other by a gap (*the gap between lower legs 19 in Fig. 1*) such that the heater element has a second gap diametrically opposed to the gap between the electrodes (*Fig. 1*), the second gap being arranged at the free end of the cantilever (*using only the two legs 19 at the bottom of Fig. 1 creates a free end at the top*).

Silverbrook as modified by Kubby do not expressly disclose that the heater element has a cross section with a lateral dimension at least triple that of the thickness.

However, Hiramatsu et al. disclose a heater element that has a cross section with a lateral dimension at least triple that of the thickness (*aspect ratio of 10-5000, lines 46-48*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element that is suspended and cantilevered (*Kubby*) and to make the lateral dimension of the heater element's cross section at least triple that of the heater element's thickness (*Hiramatsu et al.*) into Silverbrook's invention. The motivation for suspending and cantilevering Silverbrook's heater element, as taught by Kubby, is to allow the ink to flow on both sides of the heating element so that heat is dissipated from the heating element to the ink more efficiently (*col. 2, lines 4-24*). The motivation for making Silverbrook's

heater element have a cross sectional lateral dimension triple that of the thickness, as taught by Hiramatsu et al., is to increase the resistance value of the heating elements and keep the evenness of the temperature on the heating face (*col. 15, lines 49-52*).

Regarding claims 2 and 20:

Silverbrook also discloses that the gas bubble (*bubble 116*) is formed on an axis (*axis R, see Drawing A below*) which extends through the center of the nozzle (*Drawing A*).

Regarding claims 3, 21, and 39:

Silverbrook also discloses that the bubble forming chamber has a circular cross section (*cavity 447, Figure 13*).

Regarding claims 5, 24, and 42:

Silverbrook also discloses that the bubble forming liquid and the ejectable liquid are of a common body of liquid (*col. 9, lines 26-30*).

Regarding claims 6, 25, and 43:

Silverbrook also discloses that the printhead is configured to print on a page and to be a page-width printhead (*col. 2, lines 19-22*).

Regarding claims 8, 27, and 44:

Silverbrook also discloses that each heater element is configured such that an actuation energy of less than 500 nanojoules is required to be applied to that heater element to heat that heater element sufficiently to form a bubble in the bubble forming liquid thereby to cause the ejection of a drop (*col. 19, lines 8-10*)..

Regarding claims 10, 29, and 46:

Silverbrook also discloses a substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square

centimeter of substrate surface (*using the reference measurement of Figure 43 and counting the individual nozzles disclosed in the "part of cyan" section of Figure 43, calculations show that the density exceeds 10,000 per square cm:* $\frac{20 nozzles}{0.0016384 cm^2} = 12207 \frac{nozzles}{cm^2}$).

Regarding claims 11, 30, and 47:

Silverbrook also discloses that each heater element has two opposite sides (*sections of heater element 120 on the left and right sides of the chamber 488, Figure 18*) and is configured such that a gas bubble formed by that heater element is formed at both of the sides of that heater element (*bubble 116 formed on both sides, Figure 18*).

Regarding claims 13, 32, and 50:

Silverbrook also discloses that a structure that is formed by chemical vapor deposition, the nozzles being incorporated on the structure (*col. 5, lines 47-49*).

Regarding claims 14, 33, and 49:

Silverbrook also discloses a structure that is less than 10 microns thick, the nozzles being incorporated on the structure (*col. 9, lines 8-10*).

Regarding claims 15, 34, and 51:

Silverbrook also discloses a plurality of nozzle chambers each corresponding to a respective nozzle (*col. 7, lines 42-44*), and a plurality of heater elements being disposed within each chamber (*col. 9, lines 20-23 with heaters 120; Figure 12*); and

Kubby also discloses that heater elements within each chamber are formed on different respective layers to one another (col. 4, lines 45-65 and Fig. 3).

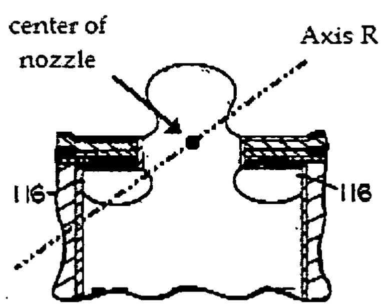
Regarding claim 23:

Silverbrook also discloses supporting the bubble forming liquid in thermal contact with each heater element (*col. 17, lines 37-43*), and supporting the ejectable liquid adjacent each nozzle (*col. 17, lines 37-40*).

Regarding claim 38:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all the limitations of claim 1 that apply to claim 38, and **Silverbrook also discloses** the steps of supplying the nozzle with a replacement volume of the liquid equivalent to the ejected drop (*col. 12, lines 59-61*); and

forming the gas bubble (*bubble 116*) on an axis (*axis R, see Drawing A below*) which extends through the center of the nozzle (*Drawing A*).



Drawing A: Figure 27 from Silverbrook '457, edited for clarification

Regarding claim 40:

Silverbrook also discloses that the heater element extends between the electrodes mounted on opposite sides of the bubble forming chamber (*heater element 121 extending between unreferenced electrodes on opposite sides of chamber, Figure 58b*).

Regarding claim 41:

Hiramatsu et al. also disclose that the heater element is less than 0.3 microns thick and more than 1 micron wide (*the width may be 0.1 mm, col. 15, lines 33-35; using the disclosed aspect ratio of 5000 from col. 15, lines 46-48, the thickness would be 0.02 microns*).

Claims 4 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and Hiramatsu et al., as applied to claims 1 and 19 above, and further in view of Lee et al. (US 6460961 B2).

Regarding claims 4 and 22:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all claimed limitations except that the serpentine form is a double omega shape wherein a first omega shape extends between the electrodes, and a second omega shape is inverted relative to the first and extends between the second gap which is in the first omega shape.

However, Lee et al. disclose a heating element (*heating element 120"*) having a double omega shape (*Fig. 5*) wherein a first omega shape (*outer annulus of heating element 120'; Fig. 5*) extends between the electrodes (*Fig. 5*), and a second omega shape (*inner annulus of heating element 120'; Fig. 5*) is inverted relative to the first (*Fig. 5*) and extends between the second gap which is in the first omega shape (*Fig. 5*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize the double omega shaped heating element of Lee et al. into the invention of Silverbrook as modified by Kubby and Hiramatsu et al. The motivation for doing so, as taught by Lee et al., is to produce a bubble ink an ink causing ink drops to be ejected (col. 1, lines 25-32).

Claims 9, 28, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of Otsuka et al. (US 5485179).

Regarding claims 9, 28, and 45:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all claimed limitations except that the heater element is configured such that the energy required to be applied thereto to heat the heater element to cause the ejection of a drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point.

However, Otsuka et al. disclose a heater element is configured such that the energy required to be applied thereto to heat the heater element to cause the ejection of a drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point (*col. 13, lines 21-28 shows that the energy required to heat the heater is less when the ambient temperature is high, and more when the ambient temperature is low; therefore, Otsuka teaches that it would take less energy to eject a drop of ink than it would to heat ink from an ambient temperature to a boiling temperature*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize Otsukia's heating configuration into the invention of Silverbrook as modified by Kubby and Hiramatsu et al. The motivation for doing so, as taught by Otsuka, is to control the temperature of the recording head based on the present ambient temperature (*col. 12, lines 41-49*).

Claims 12, 31, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of Campbell et al. (US 4870433).

Regarding claims 12, 31, and 48:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all claimed limitations except that the bubble, which each element is configured to form, is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

However, Campbell et al. disclose a bubble that each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element (*col. 3, lines 60-64*)

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize the heater element spacing of Campbell et al. to modify the invention of Silverbrook as modified by Kubby and Hiramatsu et al. The motivation for doing so, as taught by Campbell et al., is to prevent cavitational damage to the heater elements (*col. 3, lines 14-23*).

Claims 16, 18, 35, 37, 52, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of Anagnostopoulos et al. (US 6502925 B2).

Regarding claims 16, 35, and 52:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all claimed limitations except that each heater element is formed of solid material more than 90% of which,

by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

However, Anagnostopoulos et al. disclose heater elements formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50 (*Ti and TiN, col. 10, lines 31-33*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element formed of more than 90% Titanium into the invention of Silverbrook as modified by Kubby and Hiramatsu et al. The motivation for doing so, as taught by Chan (US 5870121), is to take advantage of TiN's highly stable and highly resistive characteristics (*col. 5, lines 11-22*).

Regarding claims 18, 37, and 54:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all claimed limitations except that each heater element is covered by a conformal protective coating, wherein the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

However, Anagnostopoulos et al. disclose heater elements covered by a conformal protective coating, wherein the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless (*col. 10, lines 33-39 in combination with Figure 5*).

Claim 17, 36, and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and Hiramatsu et al., as applied to claims 1, 19, and 38 above, and further in view of DeMoor et al.

Regarding claims 17, 36, and 53:

Silverbrook as modified by Kubby and Hiramatsu et al. disclose all the limitations of claims 1, 19, and 38, and **Silverbrook also discloses** that each heater element is a solid material (*HfB_2; col. 28, lines 14-18*) and is configured to be heated to a temperature above the boiling point thereby to heat the part of the bubble forming liquid to a temperature above the boiling point to cause the ejection of a drop (*col. 9, lines 26-28*).

Silverbrook as modified by Kubby and Hiramatsu et al. do not expressly disclose the heater element is less than 10 nanograms.

However, DeMoor et al. disclose a heater element is less than 10 nanograms (*page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000μm; heater width = 0.4μm. Therefore, the volume of Ti within the heater is $4*10^{-12}$ cm^3, and the volume of TiN within the heater is $2.4*10^{-11}$ cm^3. Using the known densities of Ti = 4.54 g/cm^3 and TiN = 5.22 g/cm^3, the heater element has an entire mass of 0.14344 ng*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize De Moor et al.'s heater element mass into the invention of Silverbrook as modified by Kubby and Hiramatsu et al. The motivation for doing so, as taught by De Moor et al., is that these heaters show excellent resistivity uniformity and a low TCR value (page 293, Conclusions).

Response to Arguments

Applicant's arguments filed 12/7/2006 have been fully considered but they are not persuasive.

Applicant argues that the combination of the Lee et al. reference with a reference teaching cantilevered heating elements is improper because both ends of the heating elements in Lee et al. are connected to respective electrodes. Applicant further argues that both of these respective electrodes are necessary so that either only the internal annulus or the entire heating element can be heated. However, Lee et al. discloses that if drive power is applied from the heater drive source 180 to the second electrode 160, the entire heating element is heated. Therefore, since it has been held that omission of an element and its function in a combination where the remaining elements perform the same functions as before involves only routine skill in the art, the combination is proper. ***In re Karlson, 136 USPQ 184***.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Communication with the USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shelby Fidler whose telephone number is (571) 272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Shelby L. Fidler 1/12/2007

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